

effective to produce a first product including ethylene and a heavy hydrocarbon fraction including heavy hydrocarbons. The method includes separating the ethylene from the heavy hydrocarbon fraction. At least a portion of the heavy hydrocarbon fraction is fed to the primary reactor. The portion of the heavy hydrocarbon fraction in the primary reactor is subjected to second conditions effective to convert at least a portion of the heavy hydrocarbons to ethylene.

Similarly, independent claim 55 is directed to a method for increasing ethylene yield during conversion of oxygenates to olefins including contacting a feed including an oxygenate in a primary reactor with a small pore non-zeolitic molecular sieve catalyst under conditions effective to produce a product including ethylene. A product fraction containing ethylene is separated from a heavy hydrocarbon fraction including heavy hydrocarbons. At least a portion of the heavy hydrocarbon fraction is recycled to the primary reactor.

In the June 26, 2001 Office Action, the Martino reference was relied upon for disclosing recycling of C₄ olefins to the reaction zone. However, because the Examiner asserted that the Martino reference "does not disclose the use of a non-zeolitic molecular sieve in the reaction zone," the Examiner relied upon Kaiser I for disclosing the use of SAPO catalysts in an oxygenate reaction and Kaiser II for disclosing a process for converting olefins such as butenes to lighter olefins such as ethylene and propylene with a SAPO catalyst. *See* June 26, 2001 Office Action at p. 3.

A. The Proposed Modification Renders the Martino Reference Unsatisfactory for its Intended Purpose.

The Martino reference is primarily directed to a method of making propylene and a minor proportion of butanes by contacting methanol and/or dimethyl ether with a dealuminated mordenite catalyst. As is known in the art, mordenite molecular sieve catalysts are large pore zeolite catalysts. *See Atlas of Zeolite Structure Types*, Meier et. al., Butterworth-Heinemann, 1992 (copy attached w/ May 8, 2001 Amendment). According to Martino, the dealuminated zeolite catalyst is used to improve propylene yield. (Page 1, lines 55-56). In particular, lines 24-28 of page 2 indicate that it is preferred to recycle a C₄⁺ olefin stream in order to increase the propylene yield.

If a proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. *See MPEP § 2143.01; In re Gordon*, 733 F.2d 900 (Fed. Cir. 1984). The intended purpose of the Martino reference is to produce propylene. (Abstract). However, pending independent claims 41 and 55 are directed to “a method for increasing ethylene yield during conversion of oxygenates to olefins.” Accordingly, Applicant submits that to modify the disclosure of the Martino reference to include the presently claimed features, the entire purpose of the Martino reference would be vitiated. As a result, Applicant respectfully asserts that no motivation exists for modifying the Martino reference to include the presently claimed features.

B. Combining the Byproducts with the Feedstock Results in Surprising and Unexpected Results.

Independent claim 41 includes the limitation of “feeding at least a portion of said heavy hydrocarbon fraction to said primary reactor.” Claim 55 includes the limitation of “recycling at least a portion of said heavy hydrocarbon fraction to said primary reactor.” A Declaration Under 37 C.F.R. § 1.132 of sole inventor Stephen Vaughn is being filed concurrently herewith and provides evidence of the unexpected and surprising results of Applicant’s invention.

As indicated in the Declaration, one of ordinary skill in the art would expect that the feeding or recycling of a heavy hydrocarbon fraction to a reactor containing oxygenate feedstock over a small pore molecular sieve catalyst such as SAPO-34 would produce a yield of ethylene equivalent to the average ethylene yield from the individual component reactions. However, a substantial increase or shift in ethylene yield was observed when methanol and 1-butene were combined in the presence of a non-zeolitic molecular sieve catalyst. Additionally, a 57% reduction in reaction byproducts (C₅⁺) over what would be expected was actually observed in Applicant’s studies of the combined reaction over a non-zeolitic molecular sieve catalyst. Moreover, as indicated in the declaration, it is reasonable to expect that other small pore molecular sieve catalysts would behave in a similar manner as SAPO-34.

A greater than expected result is an evidentiary factor pertinent to the legal conclusion of obviousness of the claims at issue. Particularly, when the results represent a significant, practical advantage. Based on the evidence provided in the accompanying Declaration,

Applicant respectfully submits that the 4.7 percent increase in ethylene yield and the 57% decrease in C₅⁺ hydrocarbons represent significant practical advantages. The pending claims are non-obvious over the references of record.

CONCLUSION

Allowance of pending claims 41, 43, 45, 47, 51, 55, 56 and 58-86 is respectfully requested in view of the above claim amendments and remarks.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned "Version With Markings to Show Changes Made."

The Commissioner is hereby authorized to charge any additional fees that are required or credit any overpayment to Deposit Account No. 05-1712.

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